Residential Noise Assessment

Site Address: The Richardson Arms, 684 Bradford Road, Oakenshaw, BD12 7EN

Client Name: AGC Design

Project Reference No: NP-008993

Authorisation and Version Control			
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Revision	Summary of Amendments
001	--

Disclaimer

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Delivering sustainable development by promoting good health and well-being through effective management of noise.

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1. Introduction

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a residential development ('the Proposed Development') at The Richardson Arms, 684 Bradford Road, Oakenshaw, BD12 7EN ('the Site'). The site is subject to noise from road traffic emissions.

A noise survey has been undertaken to establish the prevailing sound levels at the Proposed Development Site. The findings have subsequently been used to assess the suitability of the site for residential use. Measures required to mitigate noise impacts for the proposed development have been assessed in accordance with the relevant performance standards, legislation, policy, and guidance.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

1.1 Standards, Legislation, Policy & Guidance

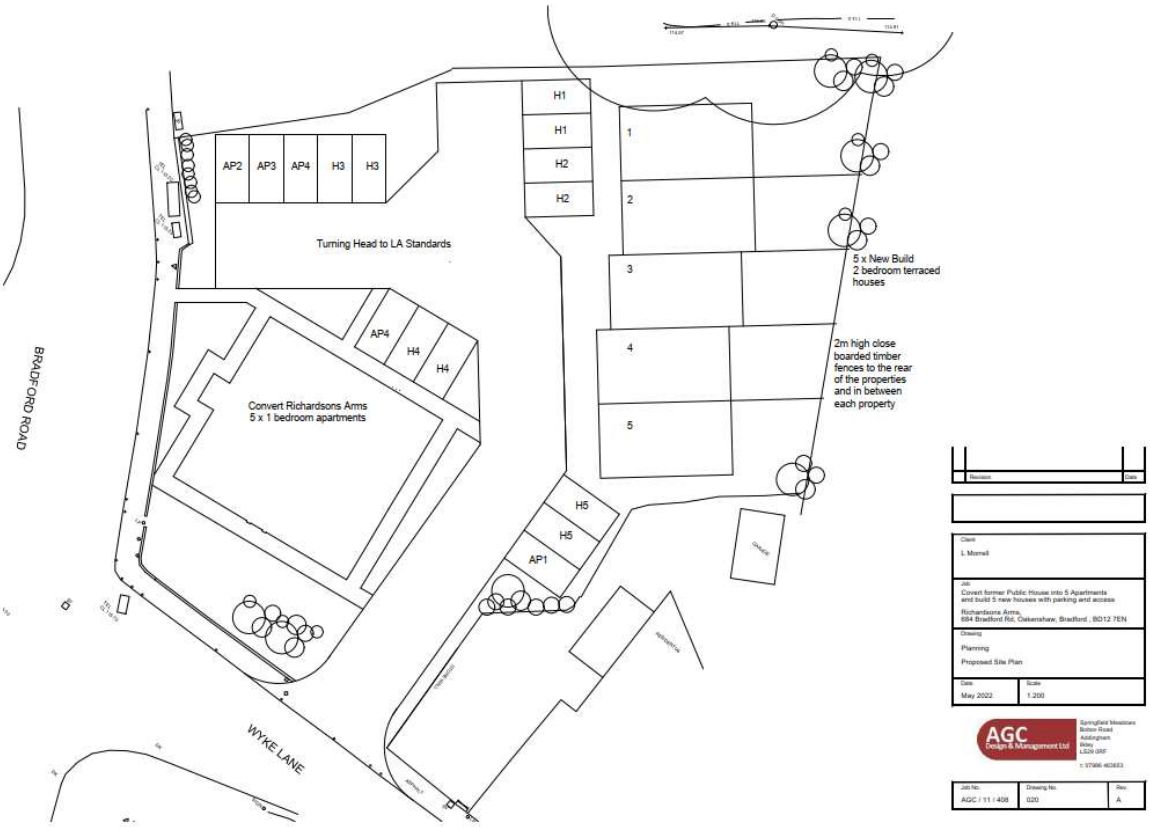
The following performance standards, legislation, policy, and guidance have been considered to ensure good acoustic design in the assessment:

- National Planning Policy Framework (2021)
- Noise Policy Statement for England (2010)
- British Standard BS8233:2014 – 'Guidance on sound insulation and noise reduction for buildings'
- Approved Document F: Volume 1 Dwellings (2021)
- Acoustics Ventilation Overheating: Residential Design Guide 2020' (AVO Guide)

Further information on the legislation can be found in Appendix B.

1.2 Proposal Brief

The proposal is for the change of use of the existing public house to 5no. residential dwelling flats and the erection of 5no. new build dwellinghouses. The figure below shows the layout of the Proposed Development.



Drawing Ref No. AGC / 11 / 408 / 020 / A from 'AGC Design & Management Ltd.'

Figure 1 – Proposed Development

2. Environmental Noise Survey

2.1 *Measurement Methodology*

The following table outlines the measurement dates and particulars.

Location	Survey Dates	Measurement Particulars
MP1	10/02/2023 – 13/02/2023	Equipment protruding from a first-floor window at 1m distance from the building façade at a height of 3.5m overlooking the M606.
MP2	10/02/2023 – 13/02/2023	Equipment mounted protruding from a first-floor window at 1m distance from the building façade on Bradford Road.

Table 1 – Measurement Methodology

The figure below outlines the site surroundings and measurement locations:

Figure 2 – Measurement Locations and Site Surroundings

2.2 *Context & Subjective Impression*

The Proposed Development Site is located on the corner of Bradford Road and Wyke Lane in Oakenshaw. The area surrounding the Site consists primarily of residential dwellings. St. Andrews Church is located to the south and M606 meets the site boundary to the east.

The acoustic environment is deemed to be moderate to high in level and the noise profile is dominated by road traffic noise emissions from the M606 and frequent vehicle pass-bys along Bradford Road.

2.3 Environmental Noise Survey Results

The following section outlines the measured sound levels during the survey. The 'typical' $L_{AFmax,1min}$ level is determined by that which is not normally exceeded more than 10 times during the night-time reference period. The time history results can be found in Appendix D.

Location	Measurement Period ('T')	Octave Frequency Band (Hz, $L_{eq,T}$ dB)						$L_{Aeq,T}$ (dB)	'Typical' $L_{AFmax,1min}$ (dB)
		125	250	500	1k	2k	4k		
MP1	$L_{eq,16hr}$ (Day)	63	62	66	71	65	51	73	--
	$L_{eq,8hr}$ (Night)	59	58	61	66	60	46	68	85
	$L_{eq,1hr}$ (Day)	65	64	67	72	65	52	73	--
	$L_{eq,1hr}$ (Night)	63	63	66	71	65	51	72	85
MP2	$L_{eq,16hr}$ (Day)	65	61	61	63	59	51	66	--
	$L_{eq,8hr}$ (Night)	58	55	57	58	53	45	61	81
	$L_{eq,1hr}$ (Day)	71	64	63	65	61	53	68	--
	$L_{eq,1hr}$ (Night)	61	58	63	60	56	49	64	81

Table 2 – Sound Level Results Summary

3. Noise Modelling

The environmental noise survey has allowed the sound levels at the proposed development to be modelled within SoundPlan 9.0. The modelling particulars are outlined in Appendix F. The sound maps showing the daytime $L_{Aeq,t}$, night-time $L_{Aeq,t}$ and night-time $L_{AFmax,1min}$ sound levels incident upon the Proposed Development can be seen in the figures below.

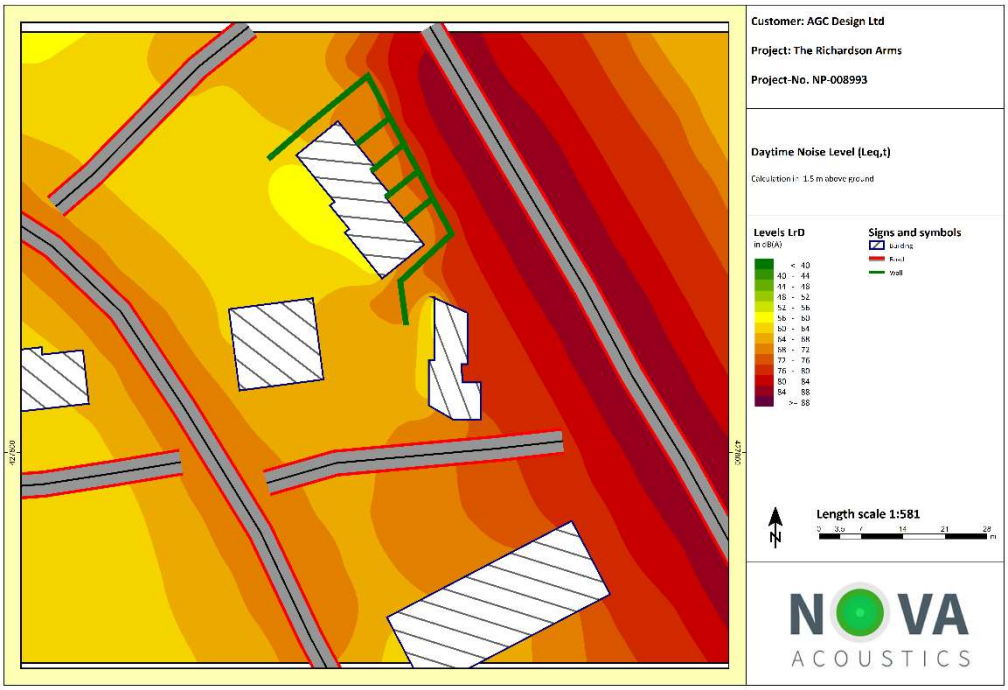


Figure 3 – $L_{Aeq,1hr}$ Ambient Sound Map (1.5m Grid Map Height)

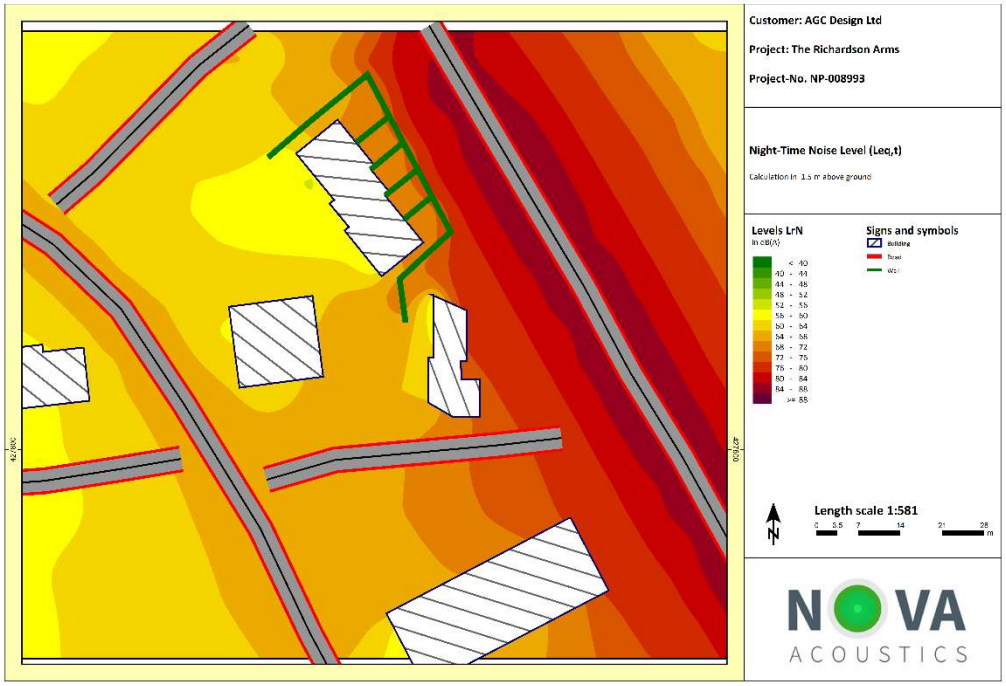


Figure 4 – $L_{Aeq,8hr}$ Ambient Sound Map (1.5m Grid Map Height)

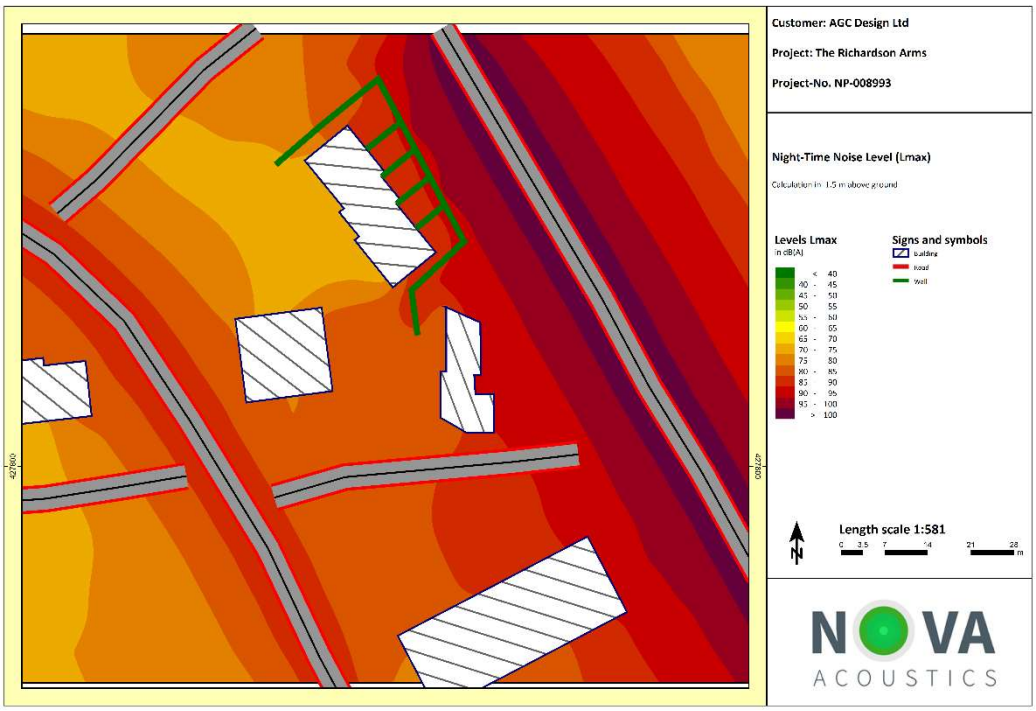


Figure 5 – $L_{AFmax,1min}$ Sound Map (1.5m Grid Map Height)

4. Noise Break-in Assessment and Sound Insulation Scheme

4.1 Internal Noise Level Criteria

The noise profile of the area is predominantly "anonymous" steady state noise sources e.g., transport. The following table outlines the internal acoustic design criteria used in the following assessment.

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$ / NR30	--
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$ / NR35	--
Sleeping (Daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$ / NR30	30 dB $L_{Aeq,8hr}$/ NR25 45 dB L_{AFmax}*

**NOTE 1: The maximum criteria have been taken from the World Health Organisation (WHO) Guidelines for Community Noise.*

**NOTE 2: ProPG:2017 which is relevant to 'New Residential' states; "In most circumstances in noise sensitive rooms at night (e.g., bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,\ F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability, and regularity of noise events".*

Note 3: BS8233:2014 states: "Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved".

Note 4: BS8233:2014 states: "The levels shown in Table 4 (criteria shown above) are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g., 1 hour, may be used, but the level should be selected to ensure consistency with the levels recommended in Table 4.

Note 5; BS8233:2014 states: "If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

Table 3 – Acoustic Design Criteria

The measured sound levels at the proposed development are assessed against the relevant criteria and a sound insulation scheme is provided to achieve a good internal acoustic environment.

As the property shares its east boundary with the M606 carriageway, it is deemed appropriate to use the highest $L_{eq,1hr}$ to inform the following assessment. This is in line with guidance given in note 4, above.

4.2 Glazing and Background Ventilation Specification

The following section provides glazing and background ventilation specifications that achieve the relevant internal noise criteria. All calculations can be found in Appendix E.

Façade Allocation

The sound levels measured at the façades of the property vary significantly. In order to correctly specify the required sound reduction, the façades have been divided into four colour groups, red, green, blue and yellow. Appropriate models of glazing and ventilation for each façade colour are shown in Table 4.

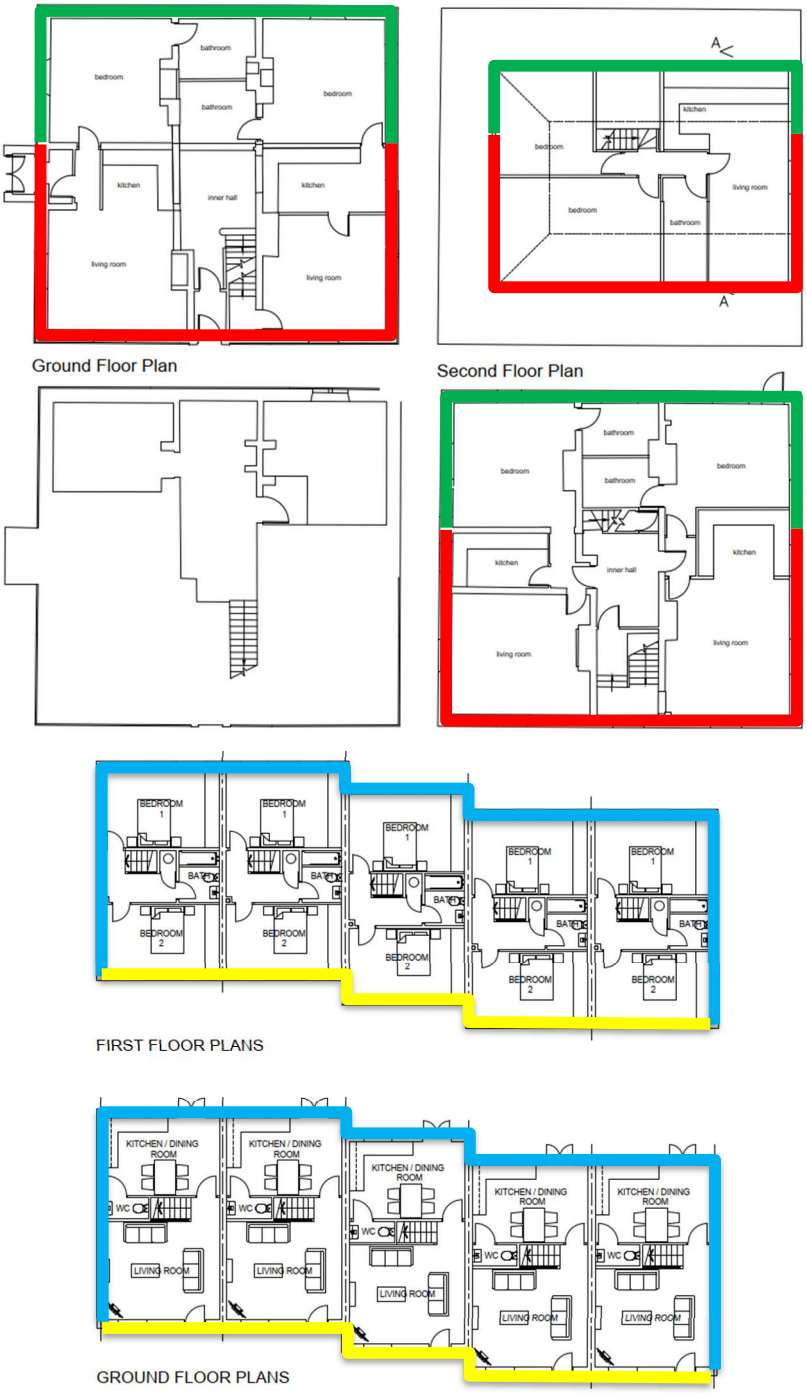


Figure 6 – Façade Allocation

Sound Insulation Scheme – Living Rooms & Bedrooms – Red Façades									
Description	Octave Frequency Band (Hz, dB)							Overall (dB)	Overall (dB)
	63	125	250	500	1k	2k	4k		
6mm Glass / 16mm Argon Cavity / 6.8mm Optiphon Glass (SRI)*	21	21	28	37	48	48	54	39 (R_W)	33 ($R_W + C_{tr}$)
Greenwoods MA3051 (2 No. Through Wall) (D_{ne})*	30	46	45	50	55	65	67	55 (D_{ne})	52 ($D_{ne} + C_{tr}$)
Sound Insulation Scheme – Living Rooms & Bedrooms – Green Façades									
Description	Octave Frequency Band (Hz, dB)							Overall (dB)	Overall (dB)
	63	125	250	500	1k	2k	4k		
6mm Glass / 16mm Argon Cavity / 6.8mm Optiphon Glass (SRI)*	21	21	28	37	48	48	54	39 (R_W)	33 ($R_W + C_{tr}$)
Living Rooms: Greenwoods 2500EA.AC1 (2 No. Trickle) (D_{ne})*	31	41	40	37	47	43	46	42 (D_{ne})	40 ($D_{ne} + C_{tr}$)
Bedrooms: Greenwoods MA3051 (2 No. Through Wall) (D_{ne})*	30	46	45	50	55	65	67	55 (D_{ne})	52 ($D_{ne} + C_{tr}$)
Sound Insulation Scheme – Living Rooms & Bedrooms – Yellow Façades									
Description	Octave Frequency Band (Hz, dB)							Overall (dB)	Overall (dB)
	63	125	250	500	1k	2k	4k		
8mm Glass / 16mm Air Cavity / 4mm Glass (SRI)*	21	22	21	28	38	40	47	33 (R_W)	28 ($R_W + C_{tr}$)
Living Rooms: Greenwoods 2500EA.AC1 (2 No. Trickle) (D_{ne})*	31	41	40	37	47	43	46	42 (D_{ne})	40 ($D_{ne} + C_{tr}$)
Bedrooms: Greenwoods MA3051 (2 No. Through Wall) (D_{ne})*	30	46	45	50	55	65	67	55 (D_{ne})	52 ($D_{ne} + C_{tr}$)
Sound Insulation Scheme – Living Rooms & Bedrooms – Blue Façades									
Description	Octave Frequency Band (Hz, dB)							Overall (dB)	Overall (dB)
	63	125	250	500	1k	2k	4k		
Living Rooms: 6mm Glass / 16mm Argon Cavity / 6.8mm Optiphon Glass (SRI)*	21	21	28	37	48	48	54	39 (R_W)	33 ($R_W + C_{tr}$)
Bedrooms: 10mm Glass / 20mm Argon Cavity / 8.8mm Optiphon Glass (SRI)*	25	28	36	43	47	49	58	45 (R_W)	40 ($R_W + C_{tr}$)
Full MVHR**									

Table 4 – Glazing Specification

**Any other window or ventilation specification capable of providing this attenuation will be suitable provided the glazing suppliers can provide an acoustic test report in accordance with BS EN ISO 10140-2:2010 or an evidence-based calculation.*

***Due to the proximity to the M606, the figures show that noise ingress due to passive ventilation is not possible in some areas. As such MVHR is recommended as outlined above.*

The following table outlines recommended noise levels from mechanical ventilation in dwellings.

Ventilation Condition	Possible System	Desirable Internal Ambient Noise Levels from Mechanical Services, L_{Aeq} (dB)		
		Bedrooms	Living Rooms	Bathrooms / Kitchens
Whole dwelling ventilation	Continuous MEV[1] at low ventilation rates Continuous MVHR[2] at minimum ventilation rates	≤ 26.0	≤ 30.0	--
Extract ventilation	Intermittent Extract Fans Continuous MEV at high ventilation rates	≤ 26.0	≤ 35.0	≤ 45.0

Table 5 – Recommended Internal Noise Levels from Mechanical Ventilation

The ventilation suppliers are required to demonstrate the acoustic performance of their proposed system either by providing an acoustic test report in accordance with BS EN ISO 10140-2:2010 or an evidence-based calculation.

5. Open Window Noise Break-In Assessment

5.1 Internal Noise Levels with Open Windows Criteria

BS8233:2014 states that when relying on closed windows to achieve the internal acoustic design criteria, appropriate alternative ventilation should be provided. Approved Document F states: "*Account should be taken of outside noise when considering whether openable windows are appropriate for purge ventilation*". If windows are open regularly to provide higher rates of ventilation to mitigate overheating, this will lead to elevated internal noise levels which could lead to undesirable living conditions. If windows are opened rarely the occupants may be able to tolerate elevated noise levels due to the inherent benefits of natural ventilation. To advise if openable windows can be used as the ventilation strategy (whilst maintaining reasonable internal noise levels), an open window assessment will be provided. The suitability of the internal noise levels will be based upon a 5 dB relaxation of the internal noise criteria and an open window providing 13 dB attenuation. If required, an alternative ventilation strategy compliant with Approved Document F will be proposed.

5.2 Open Window Assessment

This assessment will firstly consider whether the internal noise level criteria can be achieved with open windows. The criteria from Table 3 – 3 of the AVO Guide 'Windows Rarely Open'* is shown in the table below for reference.

AVO Open Window Assessment – Red Façades				
External Noise Levels	BS8233 Relaxed Criteria	Exceedance	AVO Guide Windows Rarely Open	Exceedance
73 $L_{Aeq,16hr}$ (Day)	53	+20	63	+10
72 $L_{Aeq,8hr}$ (Night)	48	+24	55	+17
85 L_{AFmax} (Night)	58	+27	78	+7
AVO Open Window Assessment – Green Façades				
External Noise Levels	BS8233 Relaxed Criteria	Exceedance	AVO Guide Windows Rarely Open	Exceedance
68 $L_{Aeq,16hr}$ (Day)	53	+15	63	+5
64 $L_{Aeq,8hr}$ (Night)	48	+16	55	+9
81 L_{AFmax} (Night)	58	+23	78	+3

Table 6 – Open Window Assessment – Part 1

AVO Open Window Assessment – Yellow Façades				
External Noise Levels	BS8233 Relaxed Criteria	Exceedance	AVO Guide Windows Rarely Open	Exceedance
65 $L_{Aeq,16hr}$ (Day)	53	+12	63	+2
63 $L_{Aeq,8hr}$ (Night)	48	+15	55	+8
78 L_{AFmax} (Night)	58	+20	78	0
AVO Open Window Assessment – Blue Façades				
External Noise Levels	BS8233 Relaxed Criteria	Exceedance	AVO Guide Windows Rarely Open	Exceedance
81 $L_{Aeq,16hr}$ (Day)	53	+28	63	+18
80 $L_{Aeq,8hr}$ (Night)	48	+32	55	+25
93 L_{AFmax} (Night)	58	+35	78	+15

Table 7 – Open Window Assessment – Part 2

**This criterion is taken from the Acoustics Ventilation and Overheating (AVO) Guide, which is relevant to the planning, design, and commissioning of new dwellings. Whilst the current project relates to new dwellings and dwellings formed by material change of use, the alternative 'new dwelling' criteria supports the principle of "Good Acoustic Design".*

The external noise levels exceed the AVO Guides 'Rarely Open' criteria which means that windows cannot be used for the primary means of ventilation and an alternate ventilation strategy is required that is capable of a higher rate of ventilation. A mechanical extract ventilation system should be installed to provide 'Whole Dwelling Ventilation' in accordance with Approved Document F. It is understood that continuous MEV extract fans installed in accordance with the specified trickle ventilators to allow the ingress of fresh air will be adequate. The ventilation system should be designed by an appropriately qualified person to ascertain compliance with the relevant Building Regulations. Special consideration should be given to 1.5 to 1.7 of Approved Document F to assist in the design of the ventilation system and to ensure the self-generated noise levels from the MEV extract fans to not exceed the specified criteria. It is noted that the windows will remain openable at the occupant's choice.

6. External Noise Level Assessment

6.1 External Noise Level Criteria

The following table outlines the external acoustic design criteria used in the following assessment.

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Relaxation	External Amenity Spaces	50 – 55 dB $L_{Aeq,16hr}$	--

Table 8 – Acoustic Design Criteria

6.2 External Noise Level Assessment

The following section analyses the external amenity area noise levels across the Proposed Development. The external amenity area sound levels are summarised in the table below.

External Amenity Area Noise Level Assessment			
Plot No.	$L_{Aeq,16hr}$ Noise Level (dB)	BS8233:2014 Criteria (dB)	Exceedance (dB)
1	66	50 – 55 $L_{Aeq,16hr}$	+11
2	71		+16
3	71		+16
4	71		+16
5	72		+17

Table 9 – BS8233:2014 External Amenity Area Noise Level Assessment

As can be seen in the table above, the noise levels within the amenity areas are predicted to exceed the criteria by up to 17 dB. It should be noted that areas that are adjacent to busy road links are known to be complicated as mitigation options are limited. A 2m barrier has been specified by the client and a further 2m berm has been added to this and modelled within SoundPlan 9.0 software. Unfortunately, noise levels within the external amenity areas are still much higher than the recommended criteria given in BS8233. As such, re-orientation of the space should be considered in order to provide full shielding by the building. As can be seen in Section 3, Figure 3, this will decrease noise levels in the external amenity areas but may still be above the criteria.

Where this is the case, BS8233 provides commentary on such situations:

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB LAeq,T, with an upper guideline value of 55 dB LAeq,T which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In

such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited. Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e., in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB LAeq,T or less might not be possible at the outer edge of these areas but should be achievable in some areas of the space."

7. Conclusion and Action Plan

The proposed development has been assessed against the acoustic design criteria and a sound insulation scheme has been provided to ensure the criteria has been achieved.

The following 'Action Plan' is outlined to ensure the design considerations and specifications from this report are duly implemented:

1. The proposed glazing and background ventilation systems, or suitable alternatives, should be installed as shown in section 4.
2. A mechanical ventilation system should be installed for dwellings along red façades to provide 'Whole Dwelling Ventilation' in accordance with Approved Document F.
3. The external amenity area should be installed as per Section 6.

The findings of this report will require written approval from the Local Authority prior to work commencing.

Appendix A – Acoustic Terminology

A-weighted sound pressure level, L_{pA}	Quantity of A-weighted sound pressure given by the following formula in decibels (dBA). $L_{pA} = 10 \log_{10} (pA/p_0)^2$. Where: pA is the A-weighted sound pressure in pascals (Pa) and $p0$ is the reference sound pressure (20 µPa)
Background Sound	Underlying level of sound over a period, T, which might in part be an indication of relative quietness at a given location
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, T, has the same mean-squared sound pressure as the sound under consideration that varies with time
Facade level	Sound pressure level 1 m in front of the facade
Free-field level	Sound pressure level away from reflecting surfaces
Indoor ambient noise	Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants
Noise Criteria	Numerical indices used to define design goals in a given space
Noise Rating (NR)	Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves
Octave Band	Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit
Percentile Level, $L_{AN,T}$	A-weighted sound pressure level obtained using time-weighting “F”, which is exceeded for N% of a specified time interval
Rating Level, $L_{Ar,Tr}$	Equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise
Reverberation time, T	Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped
Sound Pressure, p	root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound
Sound Pressure Level, L_p	Quantity of sound pressure, in decibels (dB), given by the formula: $L_p = 10\log_{10}(p/p_0)^{2.}$ Where: p is the root-mean-square sound pressure in pascals (Pa) and $p0$ is the reference sound pressure (20 µPa)
Weighted sound reduction index, R_w	Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies

Appendix B – Standards, Legislation, Policy, and Guidance

This report is to be primarily based on the following standards, legislation, policy, and guidance.

B.1 – National Planning Policy Framework (2021)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2021. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 174e, it states:

Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.

Paragraph 185 states:

Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) *Mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life.*
b) *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
c) *Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes, and nature conservation.*

B.2 – Noise Policy Statement for England (2010)

Paragraph 185 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

To achieve this vision the Statement identifies the following three aims:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- Avoid significant adverse impacts on health and quality of life.
- Mitigate and minimise adverse impacts on health and quality of life.
- Where possible, contribute to the improvement of health and quality of life.

In achieving these aims the document introduces significance criteria as follows:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. It is stated that "significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development".

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and requires that: "all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur."

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise. This can be related to the third aim above, which seeks: "where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

B.3 – BS8233:2014 'Guidance on Sound insulation and noise reduction for buildings'

BS8233 provides guidance on noise levels from sources without specific character in the built environment, based on the recommendations of the World Health Organization; specifically, 'WHO Guidelines on Community Noise, 1999'. The Guidelines on Community Noise (1999) document defines community noise to include noise from "industries" and "construction". The desirable criteria levels of steady state, "anonymous" noise in unoccupied spaces within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below.

BS8233:2014 Internal Ambient Noise Level Criteria			
Activity	**Location**	**Daytime (07:00 – 23:00)**	**Night-time (23:00 – 07:00)**
Resting	Living Room	35 dB $L_{Aeq,16hour}$	--
Dining	Dining Room/Area	40 dB $L_{Aeq,16hour}$	--
Sleeping (Daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$ 45 dB L_{AFmax}*

Table 10 – BS8233:2014 Internal Ambient Noise Level Criteria

**ProPG:2017 states that's good acoustic design can be used so that individual noise events do not normally exceed 45 dB L_{AFmax} more than 10 time a night within noise sensitive rooms such as bedrooms. However, where it is not reasonably practicable to achieve the guideline then the judgment of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number distribution, predictability, and regularity of noise events.*

It is noted, however, that where development is considered necessary or desirable, despite external noise level above WHO guidelines, the above target levels may be relaxed by up to 5 dB.

General recommendations for mitigation to enable these targets to be achieved are provided, including the use of bunds and barriers to reduce external noise and space planning and sound insulation for the control of internal noise levels.

For this assessment, the above criteria are considered to be the 'LOAEL' as defined in the NPSE in Appendix B.

B.4 – Approved Document F Volume 1: Dwellings (2021)

Approved Document F states the following in relation to noise:

- Mechanical ventilation systems, including both continuous and intermittent mechanical ventilation, should be designed and installed to minimise noise. This includes doing all of the following.
    a) Correctly sizing and jointing ducts.
    b) Ensuring that equipment is appropriately and securely fixed, such as using resilient mountings where noise carried by the structure of the building could be a problem.
    c) Selecting appropriate equipment, including following paragraph
- For mechanical ventilation systems, fan units should be appropriately sized so that fans operating in normal background ventilation mode are not overly noisy. This might require fans to be sized so that they do not operate near maximum capacity when in normal background ventilation mode.
- Account should be taken of outside noise when considering whether openable windows are appropriate for purge ventilation.
- If an exposed façade is close to an area of sustained and loud noise (e.g., a main road), then a noise attenuating background ventilator should be fitted.

B.5 – Acoustics Ventilation and Overheating – Residential Design Guide 2020

It is suggested that the desirable internal noise criteria within BS8233:2014 should be achieved considering adequate ventilation as defined by Building Regulations 'Approved Document F' ('ADF') whole dwelling ventilation. However, for a whole dwelling ventilation system such as MVHR it is considered reasonable to allow higher levels of internal ambient noise from transport sources when higher rates of ventilation are required in relation to the overheating condition.

The 'Institute of Acoustics' ('IOA') and the 'Association of Noise Consultant's ('ANC') have published 'The AVO Guide: 2020' document 2020. It provides guidance for those acousticians involved in the design of buildings to prevent noise ingress to and achieve reasonable internal levels. This provides valuable guidance on ventilation and overheating in support of the "Good Acoustic Design" principle advocated by ProPG. Along with guidance showing an acoustic assessment during the overheating condition, the AVO Guide (2020) provides a framework that has a two-level assessment procedure to estimate the potential impact on occupants:

Level 1 Risk Assessment

AVO 'Level 1' risk assessment criteria guide based on external free field ambient noise levels for dwellings relying on purge ventilation (e.g., opening windows) to prevent summertime overheating. AVO Guide Table 3-2 detailed in the figure below. To assess the possibility of overheating it is reasonable to relax the BS 8233:2014 internal ambient noise levels from opening a window by 5 decibels (5 dB). Also, it is assumed that a partially open window will provide a sound reduction of 13 dB. Therefore, to achieve internal noise levels in line with BS 8233:2014 the façade external noise levels should fall inside the levels shown in Table 3-2.

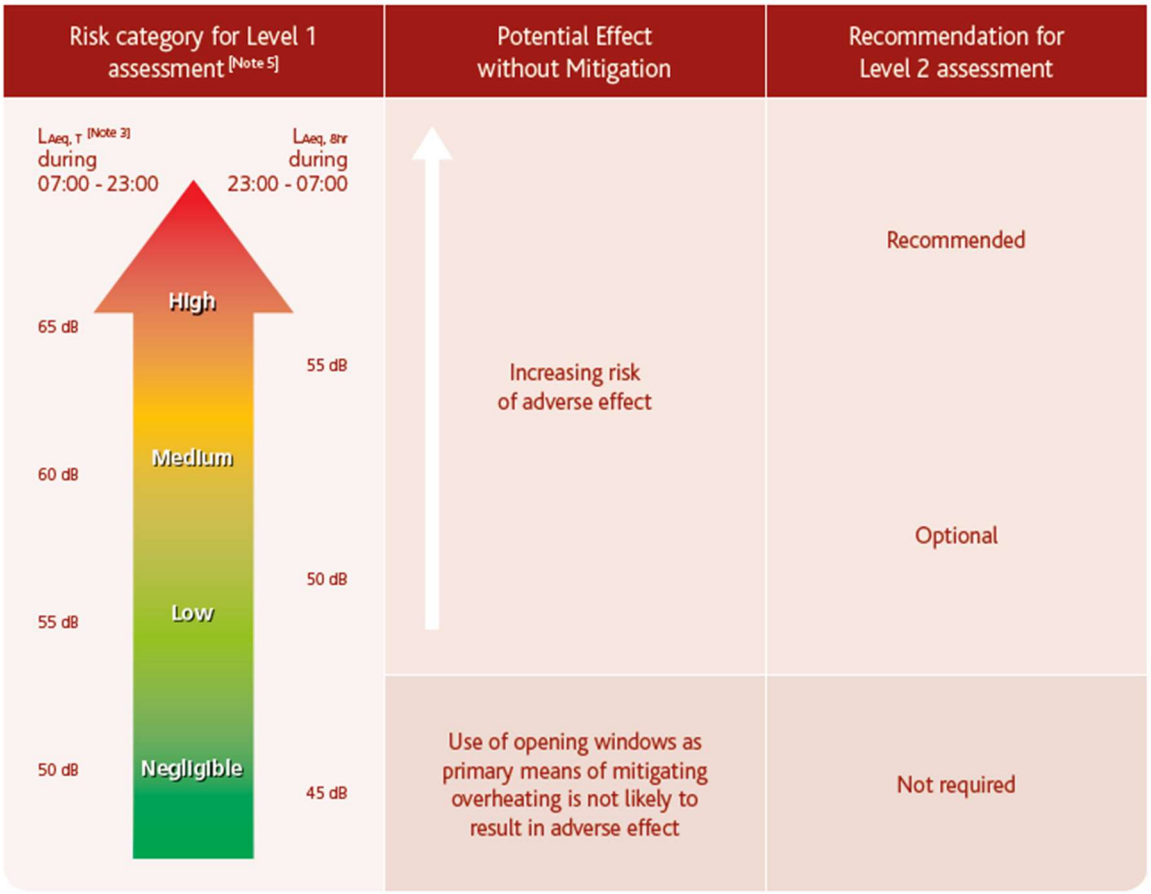


Table 3-2 of AVO Guide (2020)

Figure 7 – AVO Guide Level 1 Risk Category

The AVO Guide (2020) seeks to determine the level of risk associated with overheating in a new residential development based on the existing noise climate. The AVO risk categories are detailed in the table below with clearer categorisation.

AVO Guide (2020) Level 1 Risk Assessment			
Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	Risk Category	Mitigation
≥63 dB $L_{Aeq,16hour}$	≥55 dB $L_{Aeq,8hour}$	High Risk	Level 2 assessment recommended. Windows which are unopenable on grounds of noise will inevitably create issues for the overheating strategy.
57 – 62 dB $L_{Aeq,16hour}$	52 – 54 dB $L_{Aeq,8hour}$	Medium Risk	Level 2 assessment optional to give more confidence regarding the suitability of internal noise conditions.
54 – 56 dB $L_{Aeq,16hour}$	49 – 51 dB $L_{Aeq,8hour}$	Low Risk	
≤53 dB $L_{Aeq,16hour}$	≤48 dB $L_{Aeq,8hour}$	Negligible Risk	None required – openable windows suitable for ventilation

Table 11 – AVO Guide (2020) Level 1 Risk Assessment

Level 2 Risk Assessment:

A 'Level 2' assessment of noise is recommended where a dwelling using purge ventilation (e.g., open windows) reaches Level 1 'High Risk' or 'Medium Risk'. The Level 2 assessment guidance comments that where internal ambient noise levels are >50 dB $L_{Aeq,16hr}$ (day) or >42 dB $L_{Aeq,8hr}$ (night) then the outcome might be that the noise causes a material change in behaviour, e.g., having to keep windows closed for the majority of the time, or there is the potential for sleep disturbance.

To conduct a Level 2 assessment, the following minimum information is required:

- Statement of the overheating criteria being applied.
- Description of the provisions for meeting the stated overheating criteria. This should include, where relevant, the area of façade opening.
- Details of the likely internal ambient noise levels whilst using provisions for mitigating overheating, and the method used to predict these.
- Estimation of how frequently and for what duration such provisions are required to mitigate overheating.
- Consideration of the effect of individual noise events.
- Assessment of the adverse effect on occupants.

The figure below outlines the AVO Guide (2020) guidance for a Level 2 assessment of noise from transport sources relating to the Overheating Condition.

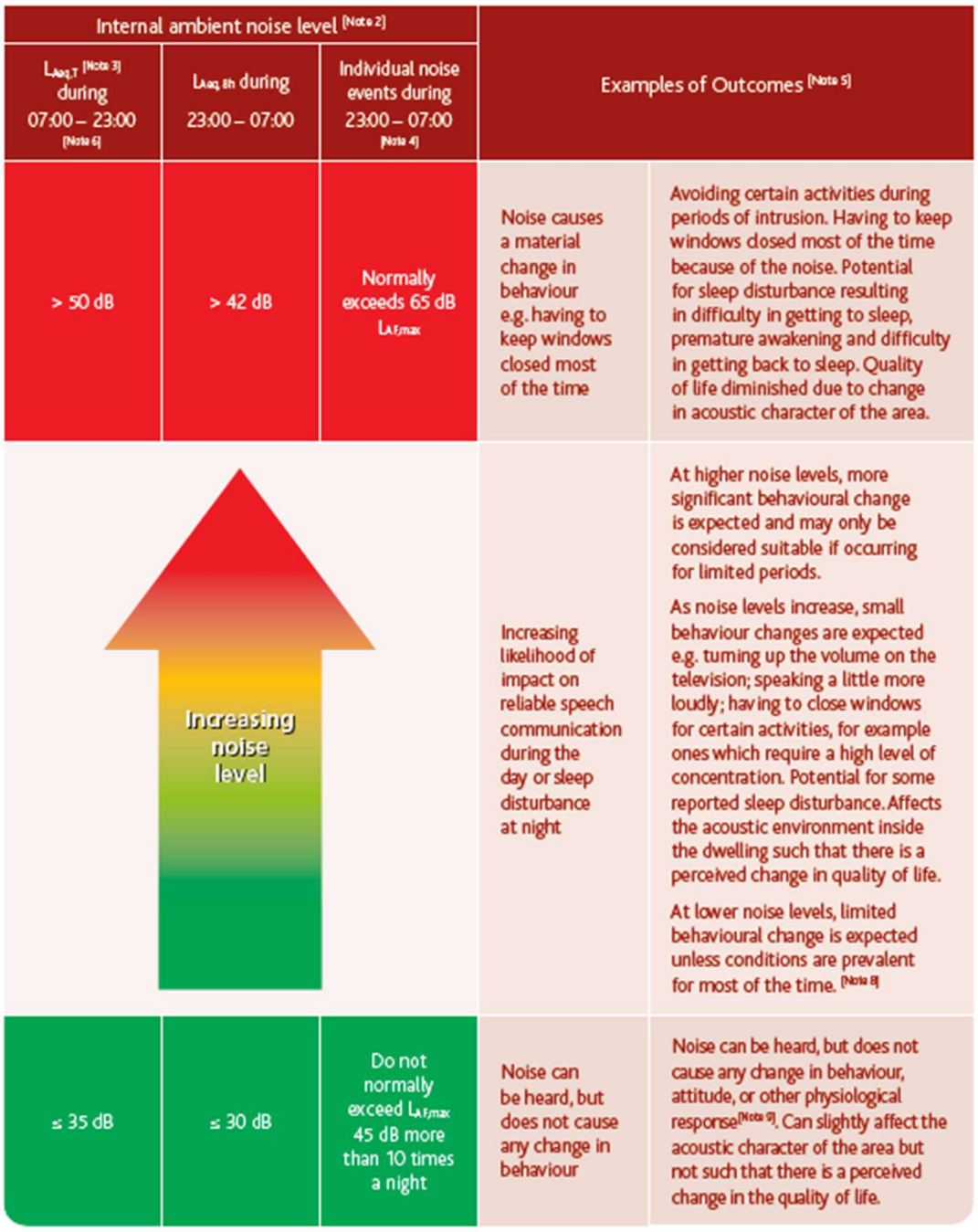


Table 3-3 of AVO Guide (2020)

Figure 8 – AVO Guide Level 2 Internal Ambient Noise Levels

Appendix C – Location Plan

SITE LOCATION PLAN
AREA 2 HA
SCALE 1:1250 on A4
CENTRE COORDINATES: 417488, 427831

Supplied by Streetwise Maps Ltd
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Licence No: 100047474

Figure 9 – Location Plans

Appendix D – Environmental Survey

D.1 – Time History Noise Data

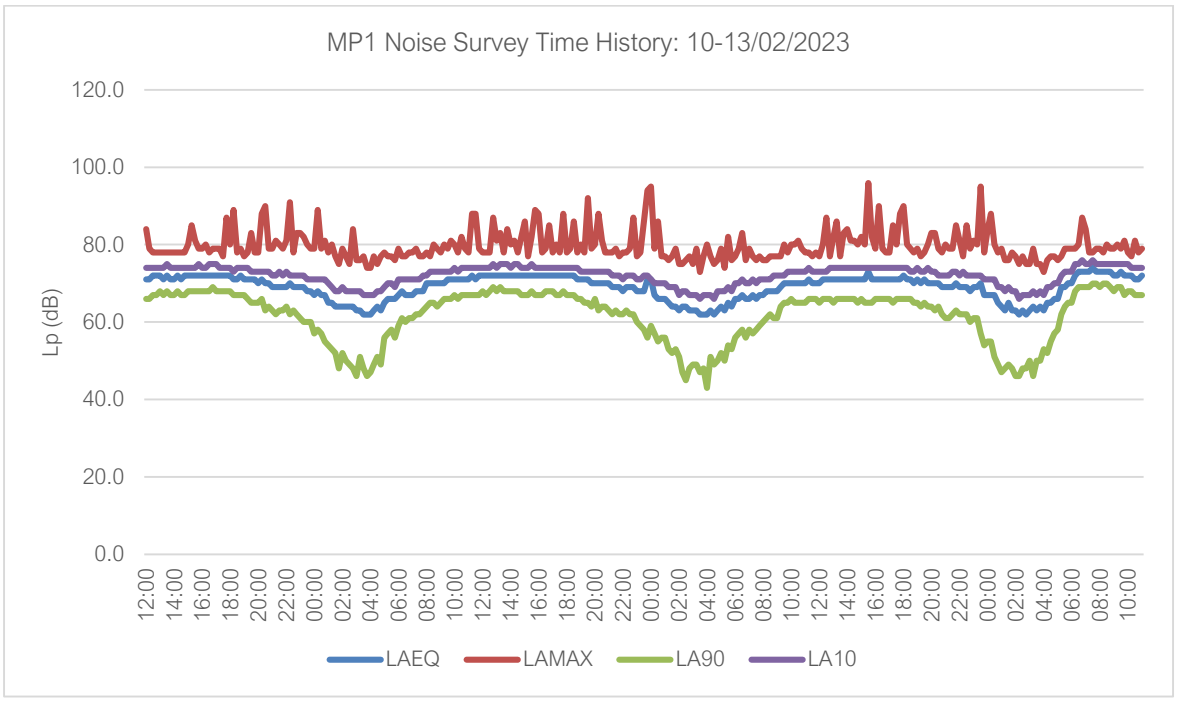


Figure 10 – MP1 Noise Survey Time History

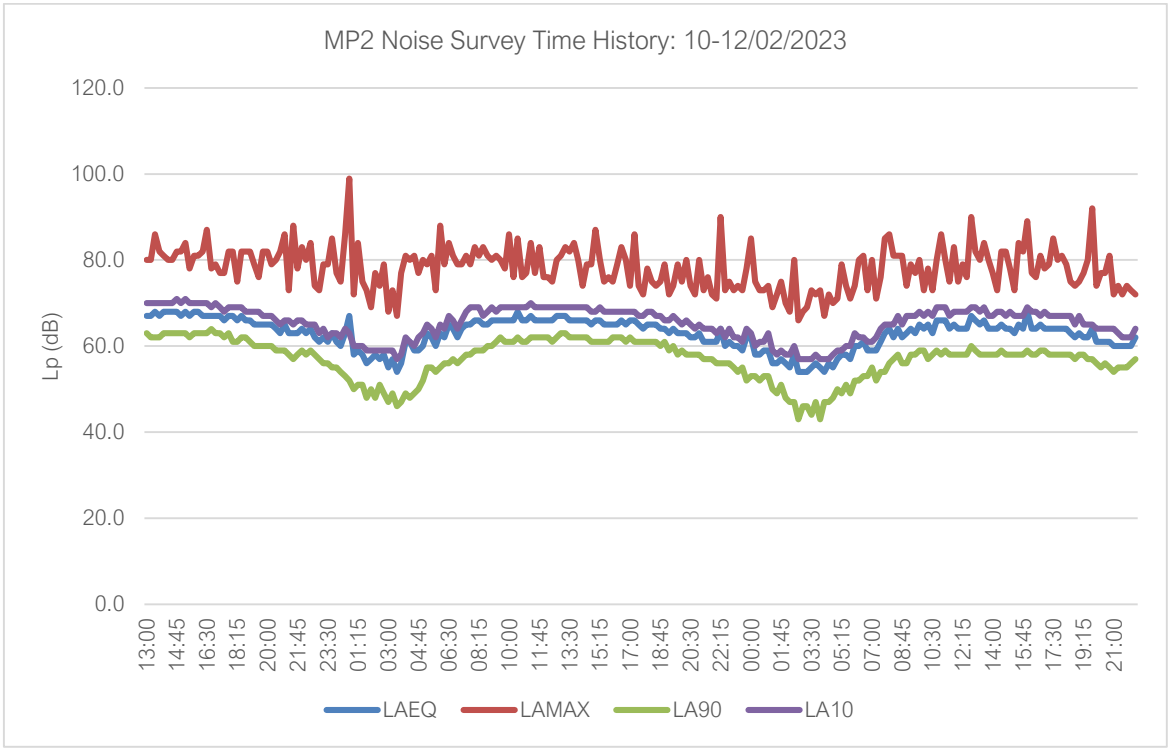


Figure 11 – MP2 Noise Survey Time History

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
CESVA SC250 Class 1 Sound Level Meter	T252860	≤0.4
CESVA CB011 Class 1 Calibrator	T253524	
CESVA SC250 Class 1 Sound Level Meter	T252915	≤0.4
CESVA CB011 Class 1 Calibrator	T251945	

Table 12 – Surveying Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation of ≤0.4 dB. All sound level meters are calibrated every 24 months and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

D.3 – Meteorological Conditions

As the environmental noise survey was carried out over a long un-manned period no localised records of weather conditions were taken. However, all measurements have been compared with met office weather data of the area, specifically the closest weather station, and the data from the weather station is outlined in the table below. When reviewing the time history of the noise measurements, any scenarios that were considered potentially to be affected by the local weather conditions have been omitted. The analysis of the noise data includes statistical and percentile analysis and review of minimum and maximum values, which aids in the preclusion of any periods of undesirable weather conditions. The weather conditions were deemed suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise. The table below presents the average temperature, wind speed and rainfall range for each 24-hour period during the entire measurement.

Weather Conditions – Scholes (Approx. 2.3km SW of Site)				
Time Period	Air Temp (^{0}C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
10/02/23 – 00:00 – 23:59	2.5 – 9.2	0.0	WSW	0.0 – 7.3
11/02/23 – 00:00 – 23:59	6.2 – 9.1	0.0	W	0.0 – 5.4
12/02/23 – 00:00 – 23:59	3.4 – 8.5	0.0	S	0.0 – 1.7
13/02/23 – 00:00 – 23:59	-1.3 – 9.0	0.0	S	0.0 – 1.5

Table 13 – Weather Conditions

Appendix E – Noise Break-in Calculations

E.1 – Façades with Background Ventilation

The façade sound reduction and predicted internal noise levels are calculated assuming the following:

- The calculation method for façade sound reduction is in accordance with BS8233:2014 and BS EN 12354-3.
- The reverberation time is typically 0.5 seconds across the relevant frequency range for a furnished living room in the UK. This value is used for both living rooms and bedrooms.
- Based on the technical drawings provided to NOVA Acoustics, window areas of 2 - 7m^2 and room volumes of 35 - 56m^3 are used in the calculations for bedrooms as a worst-case scenario. For living rooms, the calculations are based on a window area of 1.5 - 4.5 m^2 and room volume of 33 – 62m^3 as a worst-case scenario.
- The acoustic performance of the façade elements is taken from the relevant manufacturers' technical information, or the sound reduction has been predicted using INSUL 9.0.
- For background trickle ventilation a total Equivalent Area of 5000mm^2 per habitable room has been used in the calculations, which equates to 2 No. trickle vents (2500mm^2 each).

Living Room (Red Façades) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	73	69	65	64	67	72	65	52	0
Glazing Noise Ingress	30	45	41	33	27	21	14	-5	-57
Ventilation Noise Ingress	23	42	22	22	20	20	3	-12	-64
Wall Noise Ingress	12	24	15	12	5	9	2	-11	-63
Roof Noise Ingress									
Room Absorption Correction		-1	-2	-2	-2	-2	-3	-4	-5
Total Noise Ingress	**32**	**48**	**42**	**34**	**28**	**24**	**14**	**-4**	**-58**
NR30	35	59	48	39	33	30	26	24	22
Exceednce of Criteria	-3	-11	-6	-5	-5	-6	-12	-28	-80

Bedroom (Red Façades) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	73	69	65	64	67	72	65	52	0
Glazing Noise Ingress	31	45	41	33	27	21	14	-5	-57
Ventilation Noise Ingress	22	41	21	21	19	19	2	-13	-65
Wall Noise Ingress	11	23	14	11	4	8	1	-12	-64
Roof Noise Ingress									
Room Absorption Correction		-2	-2	-3	-3	-3	-4	-5	-6
Total Noise Ingress	**31**	**48**	**42**	**34**	**28**	**23**	**14**	**-5**	**-59**
NR30	35	59	48	39	33	30	26	24	22
Exceednce of Criteria	-4	-11	-6	-5	-5	-7	-12	-29	-81

Bedroom (Red Façades) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	72	67	63	63	66	71	65	51	0
Glazing Noise Ingress	29	43	39	32	26	20	14	-6	-57
Ventilation Noise Ingress	21	39	19	20	18	18	2	-14	-65
Wall Noise Ingress	10	21	12	10	3	7	1	-13	-64
Roof Noise Ingress									
Room Absorption Correction		-2	-2	-3	-3	-3	-4	-5	-6
Total Noise Ingress	**30**	**46**	**40**	**33**	**27**	**22**	**14**	**-6**	**-59**
NR25	30	55	43	35	28	25	21	19	17
Exceednce of Criteria	0	-9	-3	-2	-1	-3	-7	-25	-76

Bedroom (Red Façades) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	85	80	76	76	79	84	78	64	0
Glazing Noise Ingress	42	56	52	45	39	33	27	7	-57
Ventilation Noise Ingress	34	52	32	33	31	31	15	-1	-65
Wall Noise Ingress	23	34	25	23	16	20	14	0	-64
Roof Noise Ingress									
Room Absorption Correction		-2	-2	-3	-3	-3	-4	-5	-6
Total Noise Ingress	**43**	**59**	**53**	**46**	**40**	**35**	**27**	**7**	**-59**
NR40	45	67	56	49	43	40	37	34	33
Exceednce of Criteria	-2	-8	-3	-3	-3	-5	-10	-27	-92

Living Room (Green Façades) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	68	74	71	64	63	65	61	53	0
Glazing Noise Ingress	32	50	47	33	23	14	10	-4	-57
Ventilation Noise Ingress	30	46	33	27	29	21	21	10	-43
Wall Noise Ingress	11	29	21	12	1	2	-2	-10	-63
Roof Noise Ingress									
Room Absorption Correction		-2	-2	-3	-3	-3	-3	-5	-6
Total Noise Ingress	**35**	**52**	**48**	**34**	**30**	**22**	**21**	**9**	**-46**
NR30	35	59	48	39	33	30	26	24	22
Exceednce of Criteria	0	-7	0	-5	-3	-8	-5	-15	-68

Bedroom (Green Façades) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Measured Leq,T	68	74	71	64	63	65	61	53	0
Glazing Noise Ingress	34	51	48	34	24	15	11	-3	-56
Ventilation Noise Ingress	23	47	28	22	16	13	-1	-11	-64
Wall Noise Ingress	9	28	20	11	0	1	-3	-11	-64
Roof Noise Ingress									
Room Absorption Correction		-4	-4	-4	-5	-5	-5	-6	-8
Total Noise Ingress	**33**	**52**	**47**	**33**	**23**	**15**	**9**	**-5**	**-60**
NR30	35	59	48	39	33	30	26	24	22
Exceednce of Criteria	-2	-7	-1	-6	-10	-15	-17	-29	-82

Bedroom (Green Façades) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Measured Leq,T	64	67	61	58	63	60	56	49
Glazing Noise Ingress	26	44	38	28	24	10	6	-7
Ventilation Noise Ingress	18	40	18	16	16	8	-6	-15
Wall Noise Ingress	3	21	10	5	0	-4	-8	-15
Roof Noise Ingress								
Room Absorption Correction		-4	-4	-4	-5	-5	-5	-6
Total Noise Ingress	**26**	**45**	**37**	**27**	**23**	**10**	**4**	**-9**
NR25	30	55	43	35	28	25	21	19
Exceednce of Criteria	-4	-10	-6	-8	-5	-15	-17	-28

Bedroom (Green Façades) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Lmax Spectrum	81	84	78	75	80	77	73	66
Glazing Noise Ingress	43	60	54	44	40	26	22	9
Ventilation Noise Ingress	34	57	35	33	33	25	11	2
Wall Noise Ingress	20	38	27	22	17	13	9	2
Roof Noise Ingress								
Room Absorption Correction		-4	-4	-4	-5	-5	-5	-6
Total Noise Ingress	**42**	**61**	**54**	**43**	**39**	**27**	**21**	**7**
NR40	45	67	56	49	43	40	37	34
Exceednce of Criteria	-3	-6	-2	-6	-4	-13	-16	-27

Living Room (Yellow Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	65	71	68	61	60	62	58	50
Glazing Noise Ingress	27	41	37	31	23	15	9	-6
Ventilation Noise Ingress	26	43	30	24	26	18	18	7
Wall Noise Ingress	9	28	20	11	0	1	-3	-11
Roof Noise Ingress								
Room Absorption Correction		1	1	0	0	0	-1	-2
Total Noise Ingress	**33**	**49**	**42**	**35**	**31**	**23**	**21**	**8**
NR30	35	59	48	39	33	30	26	24
Exceednce of Criteria	-2	-10	-6	-4	-2	-7	-5	-16

Bedroom (Yellow Façade) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	65	71	68	61	60	62	58	50
Glazing Noise Ingress	29	44	40	34	26	18	12	-3
Ventilation Noise Ingress	20	44	25	19	13	10	-4	-14
Wall Noise Ingress	9	27	19	10	-1	0	-4	-12
Roof Noise Ingress								
Room Absorption Correction		-2	-2	-2	-3	-3	-3	-4
Total Noise Ingress	**31**	**48**	**41**	**35**	**26**	**19**	**12**	**-4**
NR30	35	59	48	39	33	30	26	24
Exceednce of Criteria	-4	-11	-7	-4	-7	-11	-14	-28

Bedroom (Yellow Façade) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	63	66	60	57	62	59	55	48
Glazing Noise Ingress	27	39	32	30	28	15	9	-5
Ventilation Noise Ingress	16	39	17	15	15	7	-7	-16
Wall Noise Ingress	5	22	11	6	1	-3	-7	-14
Roof Noise Ingress								
Room Absorption Correction		-2	-2	-2	-3	-3	-3	-4
Total Noise Ingress	**28**	**43**	**33**	**31**	**28**	**16**	**9**	**-6**
NR25	30	55	43	35	28	25	21	19
Exceednce of Criteria	-2	-12	-10	-4	0	-9	-12	-25

Bedroom (Yellow Façade) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Lmax Spectrum	78	81	75	72	77	74	70	63
Glazing Noise Ingress	42	54	47	45	43	30	24	10
Ventilation Noise Ingress	31	54	32	30	30	22	8	-1
Wall Noise Ingress	20	37	26	21	16	12	8	1
Roof Noise Ingress								
Room Absorption Correction		-2	-2	-2	-3	-3	-3	-4
Total Noise Ingress	**43**	**58**	**48**	**46**	**43**	**31**	**24**	**9**
NR40	45	67	56	49	43	40	37	34
Exceednce of Criteria	-2	-9	-8	-3	0	-9	-13	-25

Living Room (Blue Façades) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	81	76	72	71	74	79	72	59
Glazing Noise Ingress	32	47	43	35	29	23	16	-3
Ventilation Noise Ingress								
Wall Noise Ingress	21	34	25	22	15	19	12	-1
Roof Noise Ingress								
Room Absorption Correction		0	0	0	-1	-1	-1	-2
Total Noise Ingress	**35**	**51**	**46**	**38**	**32**	**27**	**19**	**2**
NR30	35	59	48	39	33	30	26	24
Exceednce of Criteria	0	-8	-2	-1	-1	-3	-7	-22

Bedroom (Blue Façades) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	81	76	72	71	74	79	72	59
Glazing Noise Ingress	29	44	37	28	24	25	16	-6
Ventilation Noise Ingress								
Wall Noise Ingress	21	33	24	21	14	18	11	-2
Roof Noise Ingress								
Room Absorption Correction		-2	-2	-3	-3	-3	-4	-5
Total Noise Ingress	**30**	**46**	**38**	**29**	**25**	**26**	**17**	**-2**
NR30	35	59	48	39	33	30	26	24
Exceednce of Criteria	-5	-13	-10	-10	-8	-4	-9	-26

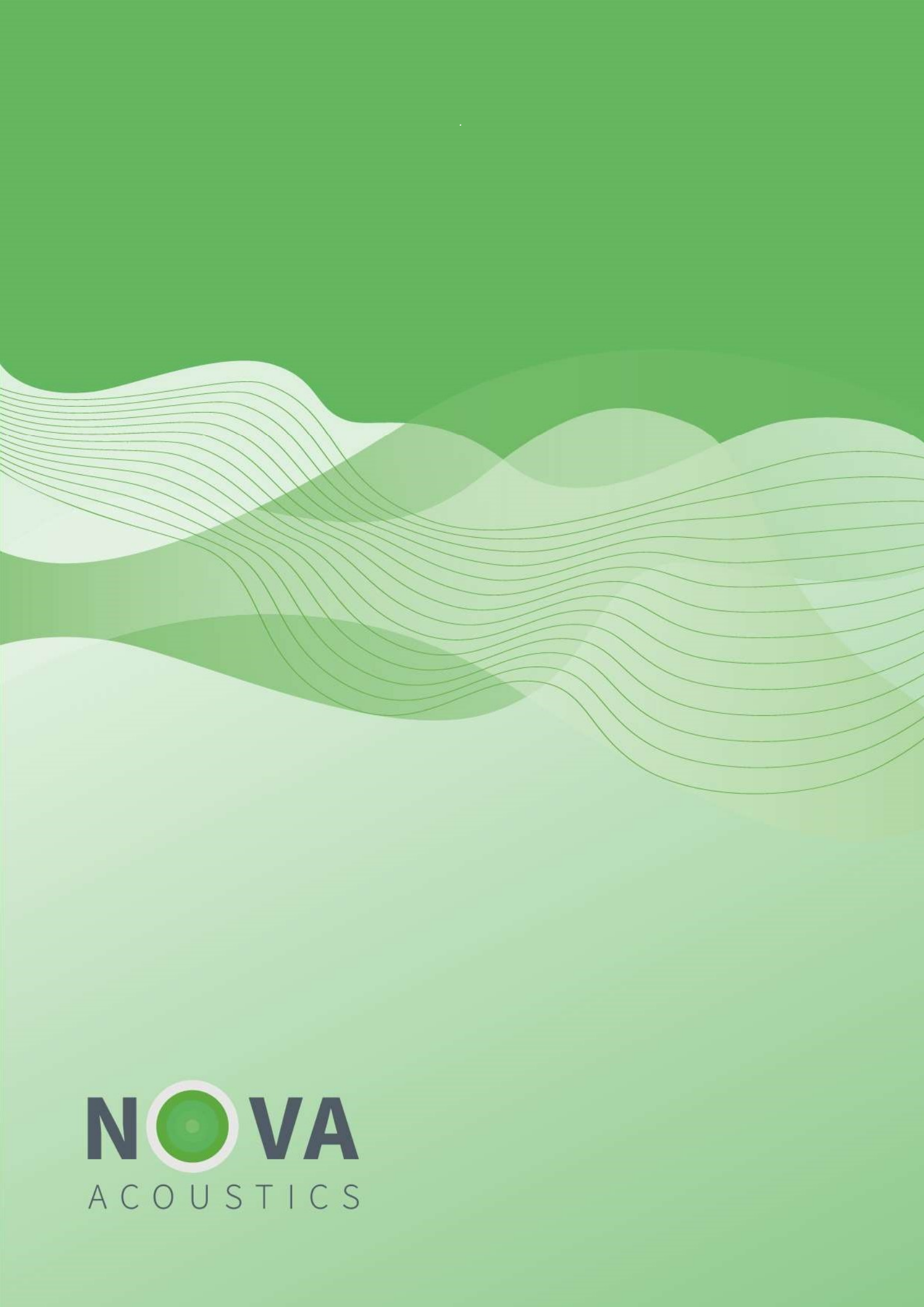
Bedroom (Blue Façades) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Leq,T Spectrum	80	74	70	70	73	78	72	58
Glazing Noise Ingress	28	42	35	27	23	24	16	-7
Ventilation Noise Ingress								
Wall Noise Ingress	20	31	22	20	13	17	11	-3
Roof Noise Ingress								
Room Absorption Correction		-2	-2	-3	-3	-3	-4	-5
Total Noise Ingress	**28**	**43**	**36**	**28**	**23**	**25**	**17**	**-3**
NR25	30	55	43	35	28	25	21	19
Exceednce of Criteria	-2	-12	-7	-7	-5	0	-4	-22

Bedroom (Blue Façades) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k
Corrected Lmax Spectrum	93	87	83	83	86	91	85	71
Glazing Noise Ingress	41	55	48	40	36	37	29	6
Ventilation Noise Ingress								
Wall Noise Ingress	33	44	35	33	26	30	24	10
Roof Noise Ingress								
Room Absorption Correction		-2	-2	-3	-3	-3	-4	-5
Total Noise Ingress	**41**	**56**	**49**	**41**	**36**	**38**	**30**	**10**
NR40	45	67	56	49	43	40	37	34
Exceednce of Criteria	-4	-11	-7	-8	-7	-2	-7	-24

Figure 12 – Noise Break-In Calculations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ACOUSTICS